



**DEPARTMENT of AGRICULTURE  
and NATURAL RESOURCES**

JOE FOSS BUILDING  
523 E. CAPITOL AVE  
PIERRE SD 57501-3182  
danr.sd.gov

**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT  
APPLICATION NO. 2032-1, Elk Creek Developers, LLC**

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Agriculture and Natural Resources concerning Water Permit Application No. 2032-1, Elk Creek Developers, LLC, 1221 Santana Court, Rapid City SD 57701.

The Chief Engineer is recommending APPROVAL of Application No. 2032-1 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing domestic water uses and water rights, 3) the proposed use is a beneficial use and 4) it is in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board with the following qualifications:

1. The well approved under Water Permit No. 2032-1 is located near domestic wells and other wells which may obtain water from the same aquifer. Water withdrawals under this Permit shall be controlled so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
2. The permit holder shall report to the Chief Engineer annually the amount of water withdrawn from the Inyan Kara aquifer.
3. Water Permit No. 2032-1 authorizes a total annual diversion of up to 30 acre-feet of water.

See report on application for additional information.

Eric Gronlund, Chief Engineer  
July 31, 2023

Report to the Chief Engineer  
On Water Permit Application No. 2032-1

Elk Creek Developers, LLC

c/o Bill Freytag

August 1, 2023

Water Permit Application No. 2032-1 proposes to appropriate an amount of water not to exceed 30 acre-feet of water annually at a maximum instantaneous diversion rate of 0.167 cubic feet per second (cfs) from one well completed into the Inyan Kara aquifer (2,090 feet deep) located in the SW  $\frac{1}{4}$  SE  $\frac{1}{4}$  of Section 9-T3N-R8E. The water is for use in a water distribution system to be located in the S  $\frac{1}{2}$  of Section 9-T3N-R8E. The site of interest is located in Meade County approximately 11 miles east of Piedmont, SD.

**AQUIFER:** Inyan Kara (INKR)

**HYDROGEOLOGY:**

The Inyan Kara aquifer exists in the saturated portions of the permeable materials that make up the Inyan Kara Group. The Inyan Kara Group is comprised of the Lower Cretaceous aged, Fall River and Lakota Formations (Downey, 1986; Martin et al., 2004). The Inyan Kara aquifer is a regional, bedrock aquifer that underlies most of the northern great plains in Montana, North Dakota, South Dakota, and Wyoming and extends up into Canada (Downey, 1986). Generally, the Lakota Formation constitutes approximately the lower two thirds of the Inyan Kara Group, and the Fall River Formation constitutes approximately the upper one third (Gott et al., 1974). The contact of these two formations is a transgressive disconformity of regional extent marking the initial incursion of the (early) Cretaceous Sea (Waage, 1959), which deposited the materials that make up the Fall River Formation (Downey, 1986). The Fall River Formation consists of a “variegated brown, red and gray to purple, calcareous, well-sorted, fine-grained sandstone, siltstone and shale containing mica,” and is estimated to be 100 to 200 feet thick (Martin et al., 2004). The Lakota Formation consists of a “yellow, brown, red-brown, and gray to black claystone, silty pebble conglomerate, and massive to thin-bedded, cross-bedded sandstone,” that can be locally interbedded with fresh-water limestone and bituminous coal beds (Martin et al., 2004). The estimated thickness of the Lakota Formation ranges from 35 to 500 feet (Martin et al., 2004). For the purpose of appropriations, the Water Management Board and the SD DANR-Water Rights Program consider the Inyan Kara Group as one aquifer.

The Inyan Kara aquifer is sometimes locally called the Sundance aquifer (Water Rights, 2023d). However, it should not be confused with the Sundance aquifer as defined by the SD DANR-Water Rights Program, which is an aquifer deposited during the Jurassic Period (Water Rights, 2023c and 2023d).

The Inyan Kara Group outcrops in the Black Hills but is otherwise buried in South Dakota (shown in Figure 1) (Martin et al., 2004). In South Dakota, the Inyan Kara aquifer is primarily under confined conditions, except where it outcrops in the Black Hills (SDGS, 2023; Water



Rights, 2023b and 2023d). Most of the Inyan Kara aquifer is overlain by the Skull Creek Shale, which serves as a relatively impermeable barrier between the Inyan Kara and Dakota aquifers (Schoon, 1971). Where the Skull Creek Shale is not present, the Inyan Kara aquifer discharges into the Dakota aquifer (Schoon, 1971). Below most of the Inyan Kara aquifer, the Morrison Shale acts as an impermeable barrier between the Inyan Kara aquifer and the underlying aquifers below it (Schoon, 1971).

In western South Dakota, the Inyan Kara aquifer is estimated to range between 81 to 475 feet thick, underly approximately 23,239,040 acres, and contain approximately 324,169,440 acre-feet of recoverable water in storage (Allen et al., 1985). In Meade County, the Inyan Kara Group underlies approximately 2,107,520 acres, with an average aquifer thickness of approximately 230 feet and contains approximately 36,354,720 acre-feet of recoverable water in storage (Allen et al., 1985).

A well completion report is on file for the existing well proposed to be used by Water Permit Application No. 2032-1. The report lists “Till” from 0 to 30 feet below the ground surface, “Shale” from 30 to 821 feet, “Greenhorn” from 821 to 871 feet, “Shale” from 871 to 1,557 feet, “Newcastle” from 1,551 to 1,582 feet, “Shale” from 1,582 to 1,740 feet, “Inyan Kara” from 1,740 to 2,060 feet, and “Morrison” from 2,060 to 2,090 feet. The static water level was listed at 379 feet below the ground level at the time of well completion (February 13, 2023). Based on the submitted well completion report, well completion reports on file for nearby wells completed into the aquifer, and lithologic logs on file for nearby observation wells, the Inyan Kara aquifer is confined at the existing well location (SDGS, 2023; Water Rights, 2023b and 2023d).

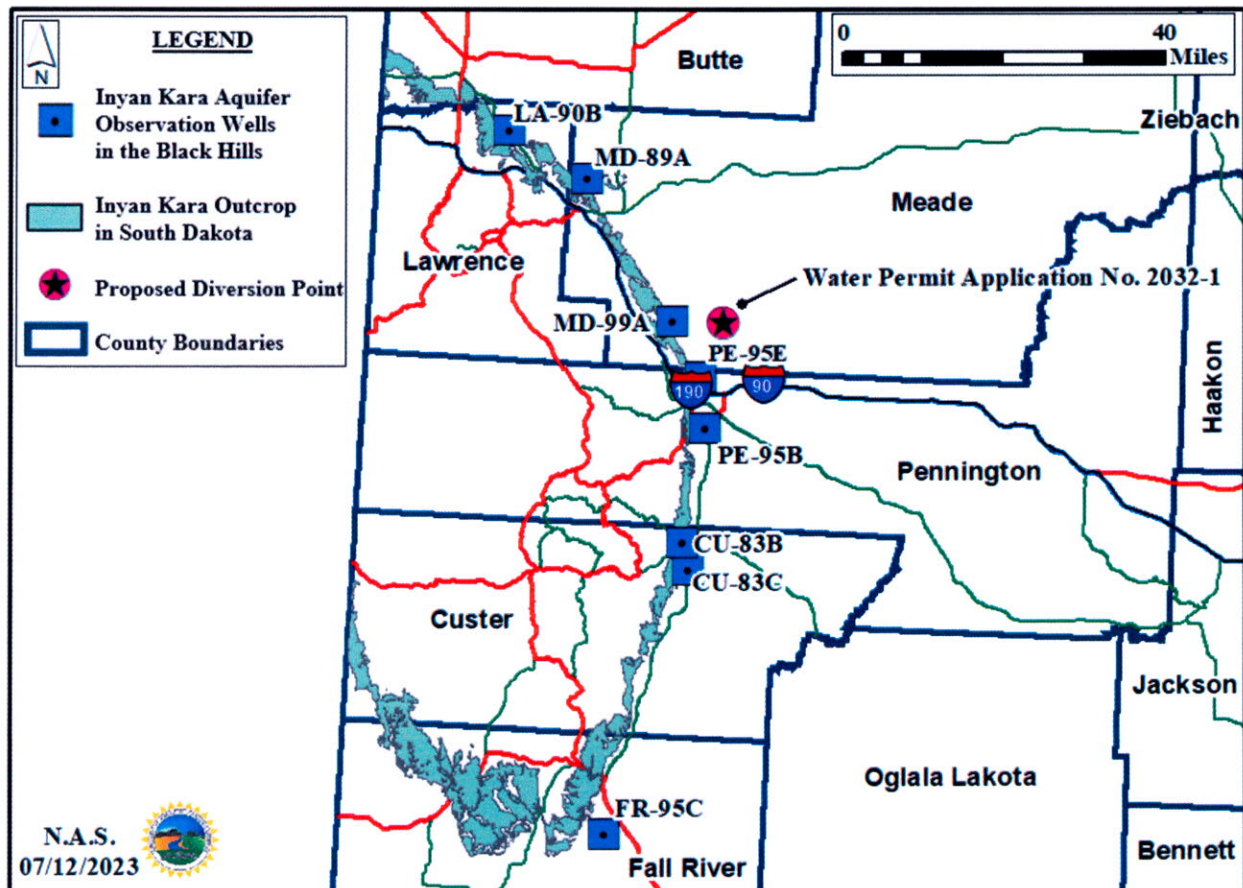
#### **South Dakota Codified Law (SDCL) 46-2A-9**

Pursuant to SDCL 46-2A-9, “A permit to appropriate water may be issued only if there is a reasonable probability that there is unappropriated water available for the applicant’s proposed use, that the diversion point can be developed without unlawful impairment of existing domestic water uses and water rights, and that the proposed use is a beneficial use and in the public interest as it pertains to matters of public interest within the regulatory authority of the Water Management Board as defined by SDCL 46-2-9 and 46-2-11.” This report will address the availability of unappropriated water and the potential for unlawful impairment of existing domestic water uses and water rights within the Inyan Kara aquifer.

#### **WATER AVAILABILITY:**

Water Permit Application No. 2032-1 proposes to appropriate water from the Inyan Kara aquifer. The probability of unappropriated water being available from the aquifer can be evaluated by considering SDCL 46-6-3.1, which requires “No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable that the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source. An application may be approved, however, for withdrawals of groundwater from any groundwater formation older than or stratigraphically lower than the greenhorn formation in excess of the average estimated annual recharge for use by water distribution systems.” The Inyan Kara aquifer is older than and

stratigraphically lower than the Greenhorn Formation (Fahrenbach et al., 2010), and the applicant's proposed use is for use in a water distribution system as defined by SDCL 46-1-6(17). Therefore, the Water Management Board's authority to approve this application is not restricted by whether or not recharge exceeds withdrawals. However, a hydrologic budget analyzing average annual recharge and average annual withdrawal rates to and from the Inyan Kara aquifer were included in this technical report for the information of the Chief Engineer and Water Management Board.



**Figure 1.** Inyan Kara outcrop in the Black Hills in South Dakota (Martin et al., 2004), Inyan Kara observation wells in the Black Hills (Water Rights, 2023b) and the location of the existing well proposed to be used by Water Permit Application No. 2032-1 (Water Rights, 2023d)

## HYDROLOGIC BUDGET:

### Recharge

Recharge to the Inyan Kara aquifer is primarily through streamflow losses and the infiltration of precipitation where the formation outcrops (Lobmeyer, 1985). Additionally, the aquifer appears to be receiving some recharge through upward leakage from underlying bedrock units (Hamilton, 1986; Lobmeyer, 1985); such as, the Madison Limestone, Minnelusa Formation, and Englewood Formation (Gott et al., 1974; Hamilton, 1986).

Precipitation data for the Black Hills (in South Dakota) from 1950 to 1998 was analyzed to estimate a total recharge yield for the Inyan Kara aquifer. On average during this period, the



Inyan Kara outcrop received approximately 17.84 inches of precipitation per year and lost approximately 17.05 inches of precipitation per year to evapotranspiration (Driscoll and Carter, 2001). By subtracting these values, an estimated total recharge yield of 0.79 inches of precipitation per year over the Inyan Kara outcrop in the Black Hills was calculated. A recharge factor of 0.80 was used for the Inyan Kara aquifer because the formation contains more shale layers than the Madison, Minnelusa, and Minnekahta Formations, which are predicted to experience direct runoff and are assumed to have a recharge factor of 1.0 (Driscoll and Carter, 2001). By multiplying the estimated total recharge yield of 0.79 inches per year by a recharge factor of 0.8, it is expected 0.63 inches of precipitation per year contributes to recharge of the Inyan Kara aquifer on the Black Hills outcrop. The remaining 0.16 inches per year are assumed to contribute to runoff. The Inyan Kara outcrop overlies approximately 219,700 acres in the Black Hills and when multiplied by the recharge estimate of 0.63 inches per year, the average annual recharge rate to the Inyan Kara aquifer is approximately 11,600 acre-feet per year (Driscoll and Carter, 2001). This is a conservative estimate that accounts for precipitation losses to evapotranspiration and runoff. Additional recharge is likely occurring due to upward leakage from underlying aquifers and groundwater inflow from out of state.

Bredehoeft and others (1983) attempted to model flows between the Madison Group, Inyan Kara Group, Dakota/Newcastle Sandstone, and confining shale units; however, the model is based on dated information when newer information is available that could modify the flow analysis results. The flow model computed by Bredehoeft and others (1983) estimated that approximately 22.7 cfs, or roughly 16,000 acre-feet per year, flows from the Madison Group to the Inyan Kara aquifer, which is currently the only estimate of recharge to the Inyan Kara aquifer from the underlying aquifers available.

Collectively, the estimated average annual recharge to Inyan Kara aquifer is approximately 27,600 acre-feet per year (Bredehoeft et al., 1983; Driscoll and Carter, 2001).

## **Discharge**

Discharge from the Inyan Kara aquifer occurs primarily through well withdrawals (Water Rights, 2023d), evapotranspiration where the formation outcrops and the hydraulic head of the aquifer is near the ground surface, seepage to surface water features when the hydraulic head of the aquifer is above the stage of the surface water feature the aquifer is hydrologically connected to, and groundwater outflow to aquifers in contact with the Inyan Kara aquifer.

Currently, there are 207 water rights/permits authorized to withdraw water from the Inyan Kara aquifer, plus one application held in abeyance (Water Permit Application No. 2686-2 for Powertech (USA)) requesting 274.2 acre-feet of water annually from the Inyan Kara aquifer (Water Rights, 2023c). Four additional water rights/permits (Nos. 6011-3, 6091-3, 6128-3 and 6257-3) are included in this analysis as they are authorized to withdraw from the Dakota and Inyan Kara aquifers; however, for this analysis these water rights/permits are assumed to withdraw only from the Inyan Kara aquifer (Water Rights, 2023c). Additionally, there is one future use permit (Future Use Permit No. 1780-2, held by the Town of New Underwood) reserving 142 acre-feet of water annually from the Inyan Kara aquifer (Water Rights, 2023c). For

the purpose of estimating average annual withdrawals, the future use permit is assumed to be fully developable for a total of 142 acre-feet per year.

Of the 211 Inyan Kara aquifer water rights/permits, 194 are for non-irrigation use (Water Rights, 2023c). Eleven municipal or suburban housing development water rights/permits are known by the DANR to be on standby for emergency use because they are obtaining their water from a rural water system or are supplied by a municipality (Table 1) (Drinking Water Program, 2023; Water Rights, 2023c). As such, the average annual water use for these water rights has been estimated to be zero acre-feet per year.

**Table 1.** Inyan Kara municipal or suburban housing development water rights/permits with wells on stand-by (Drinking Water Program, 2023; Water Rights, 2023c)

Permit No.	Status	Name	Use Type	Authorized Diversion Rate (cfs)	Served By:
1360-2	LC	Aladdin Investments Inc	SHD	0.15	Supplied by Rapid City
2224-3	LC	Sunshine Acres Water System	SHD	0.22	Mid Dakota RWS
2279-3	LC	Camelot Land	SHD	0.22	Supplied by City of Pierre
2442-2	LC	Rainbow Water Co Inc	SHD	0.09	Supplied by Rapid City
473-1	LC	Town of Fruitdale	MUN	1	Butte-Meade RWS
595-3	LC	City of Onida	MUN	1.11	Mid Dakota RWS
1198-3	LC	Town of Mound City	MUN	0.17	WEB RWS
1647-2	LC	Town of Quinn	MUN	0.2	West River/Lyman Jones RWS
1712-3	LC	City of Ipswitch	MUN	0.19	WEB RWS
2263-2	LC	Town of Belvidere	MUN	0.17	West River/Lyman Jones RWS
6735-3	LC	City of Eureka	MUN	1.48	WEB RWS

LC: Licensed Water Right, SHD: Suburban Housing Development, MUN: Municipal, RWS: Rural Water System

The average annual withdrawal rate for the fourteen Inyan Kara aquifer non-irrigation water rights/permits who operate a Concentrated Animal Feeding Operation (CAFO) was estimated by multiplying the number of permitted animals by the average daily use for each type of animal permitted (Ag-Info Centre, 2009; Drennon, 2021; Water Rights, 2023c) (Table 2). However, if that estimated withdrawal rate was higher than the annual limit authorized by the water right/permit, the annual volume limit was assumed to be the estimated use for that user. Overall, the average annual withdrawal rate for the Inyan Kara aquifer water rights/permits who operate a CAFO is approximately 1,095 acre-feet per year (Ag-Info Centre, 2009; Drennon, 2021; Water Rights, 2023c) (Table 3).



**Table 2.** Estimated annual water use for the Inyan Kara aquifer water rights/permits who operate CAFO (Ag-Info Centre, 2009; Drennon, 2021; Water Rights, 2023c)

Permit No.	Status	Name	Authorized Diversion Rate (cfs)	County	Annual Limit (ac-ft/yr)	Estimated Livestock Needs (ac-ft/yr)	Estimated Use (ac-ft/yr)
2178-2	LC	Fall River Feed Yard LLC	0.62	FR	449	280.2	280.2
4965-3	LC	Dakota Feeding Company LLC	0.33	SU	239	168	168
5890-3	LC	Evergreen Colony	0.14	FA	101	28.4	28.4
6011-3	LC	Plainview Colony Httm	0.22	ED	159	29.6	29.6
6091-3	PE	Brentwood Colony	0.1	FA	72	34.3	34.3
6128-3	LC	Deerfield Httm Brethren	0.27	ED	196	44.8	44.8
6257-3	PE	Thunderbird Colony	0.2	FA	145	83	83
6376-3	LC	LDL Cattle Company	0.22	ED	159	112	112
6377-3	LC	LDL Cattle Company	0.27	ED	196		
6619-3	PE	PJ Werdell & Sons	0.33	HD	239	112	112
6851-3	LC	Todd Cowan	0.15	HY	109	99.5	99.5
7034-3	LC	Vogel & Sautner Farms	0.123	PT	89	44.8	44.8
7098-3	LC	Mike & Jessie Fuller	0.04	SU	29	46.0	29
7209-3	LC	Paul Oberlitner	0.04	PT	29	61.6	29
LC: Licensed Water Right; PE: Water Permit			TOTAL (acre-feet/year):		2,212	1,145	1,095
FR: Fall River; PT: Pennington; SU: Sully; FA: Faulk; ED: Edmunds; HY: Hyde; HD: Hand							

There are 44 non-irrigation water rights/permits that are required to report their annual usage from the Inyan Kara aquifer to the DANR-Water Rights Program (Water Rights, 2023 and 2023f). Of the 44 water rights/permits, 24 have withdrawn a consistent volume from the Inyan Kara aquifer each year. As such, the average annual withdrawal rate estimated for these water rights/permits was the reported volume of water withdrawn by these users averaged over the respective period of reported record for each water right/permit (Water Rights, 2023c and 2023f) (Table 3). The remaining 20 non-irrigation water rights/permits required to report their annual usage have had less consistent withdrawals over their respective period of record or are still undergoing development of their permit (Water Rights, 2023c and 2023f). The average annual withdrawal rate estimated for these water rights/permits was assumed to be their entire respective annual volume limitation. Overall, the average annual withdrawal rate for the Inyan Kara non-irrigation water rights/permits that are required to report their annual volume withdrawn (to the Water Rights Program) is approximately 3,991 acre-feet per year (Table 3).

**Table 3.** Estimated annual water use for the Inyan Kara aquifer water rights/permits who are required to report their withdrawal rate to the Water Rights Program (Water Rights, 2023c and 2023f)

Permit No.	Name	Status	Use Type	Authorized Diversion Rate (cfs)	Priority Date	Annual Volume (acre-feet/year)	Estimated Use (acre-feet/year)	Estimation Method
1826-1	Golden Valley Water Company LLC	LC	SHD	0.267	09/01/2004		18.4	Average
1837-1	Guy Mann (Prairie Haven)	LC	SHD	0.22	02/28/2005		2.8	Average
1846-1	Dennis or Anna Mae Beckham	LC	SHD	0.1	05/26/2005		3.1	Average
1857-1	Shade Valley Inc	LC	COM	0.33	03/03/2006		0.74	Average
1874-1	Viewfield Rural Water Assoc.	LC	RWS	0.212	01/03/2007		15.4	Average
1898-1		LC	RWS	0.394	11/14/2007		31	Average
1903-1	Castle Rock Group	LC	DOM	0.11	05/19/2009		15.1	Average
1906-1	City of Sturgis	LC	MUN	0.222	08/21/2009		2.7	Average
1958-1		LC	MUN	0.088	04/11/2016	8.1		
1920-1	Elk Valley Ranchettes Homeowners Assoc.	LC	SHD	0.1	01/24/2011		7.67	Average
1968-1	Venekamps LLC	PE	SHD	0.11	04/27/2017	29	29	Volume
1983-1	Continental Resources	PE	IND	0.5	07/10/2018	360	360	Volume
1989-1	Luff Exploration Company	PE	IND	0.1	04/09/2019	58.8	58.8	Volume
2165-2	Tightline Lake Estates Homeowners Assoc. Inc.	LC	COM, SHD, REC, DOM	0.07	02/19/1991		8.8	Average
2285A-2	West River - Lyman Jones	LC	RWS	0.56	05/17/1993		130.9	Average
2464-2		LC	RWS	0.76	07/26/2011	360	130.1	Average
2465-2		LC	RWS	1	07/26/2011	360	175	Average
2797-2		PE	RWS	1	04/01/2019	455	455	Volume
2538-2	JKRK Propoerties LLC - Timberwood Park	PE	SHD	0.244	08/30/2004		15	Average
2543-2	Southern Black Hills Water System	LC	SHD	0.19	09/30/2004		16.1	Average
2752-2		PE	RWS	0.33	04/25/2016	170	170	Volume
2752A-2		PE	RWS	0	04/25/2016	0		
2754-2	Steve Simunek	LC	COM	0.1	05/31/2016		16.5	Average
2550-2	Town of Hermosa	LC	MUN	0.22	01/25/2005	162	53	Average
2596-2	City of Wall	LC	MUN	0.6	07/24/2006	261	147.2	Average
2601-2	Grandview Land LLC	LC	SHD	0.33	09/01/2006	206	206	Volume
2622-2	Owanka Rural Water Assoc.	LC	RWS	0.39	10/09/2007		22.8	Average
2635-2	Fall River Water Users District	LC	SHD	0.1	07/17/2008		9.1	Average
2819-2		PE	RWS	0.09	06/01/2021	24.6	24.6	Volume
2778-2	Western Construction Inc	PE	COM	0.17	11/13/2017	31	31	Volume
2832-2	Reel Simple LLC	PE	WDS	0.044	11/08/2021	10	10	Volume
8197-3	Aberdeen Farm LLC	PE	COM	0.16	01/29/2016	72.1	72.1	Volume
8197A-3	Mina North LLC	PE	WDS, RWS, COM, GEO	0				
8299-3	Aberdeen Energy LLC	PE	IND	1.33	09/28/2018	968	968	Volume
8420-3	Vogel Farms PTR	PE	GEO	0.12	01/28/2020	88.7	88.7	Volume
8607-3	Spring Creek Hutterian Brethren Inc	PE	COM, DOM	0.22	02/15/2022	100	100	Volume
1996-1	Dylan Gingras	PE	SHD	0.133	04/14/2020	48	48	Volume
1999-1	Rafter Properties LLC	PE	WDS	0.17	07/23/2020	74	74	Volume
2841-2	Hwy 79 LLC	PE	COM, WDS	0.89	02/18/2022	217.9	217.9	Volume
1855-1	Wink Cattle Co	LC	COM, DOM	0.087	01/26/2006		19	Average
1975-1		PE	COM, DOM	0.069	02/20/2018			
1975A-1		PE	COM, DOM	0	12/03/2018			
2830-2	Weinreis Brothers	PE	COM	0.33	10/04/2021	160	160	Volume
8635-3	Big Watt Digital SD LLC	PE	COM	0.89	05/09/2022	76.7	77	Volume
						<b>TOTAL:</b>	<b>3,991</b>	

LC: Licensed Water Right; PE: Water Permit; RWS: Rural Water System; SHD: Suburban Housing Development; DOM: Domestic; MUN: Municipal; COM: Commercial; IND: Industrial; GEO: Geothermal; WDS: Water Distribution System



The DANR-Drinking Water Program requires public water systems to report their annual production rate. Thirteen water rights/permits were identified for public water systems using the Inyan Kara aquifer as their only water source (Water Rights, 2023c). The 2022 reported production rate for these systems was assumed to be the average annual withdrawal rate for their associated water rights/permits in this analysis (Table 4) (Drinking Water Program, 2023).

**Table 4.** Estimated annual use for the water rights/permits for public water systems using the Inyan Kara aquifer as their only water source (Drinking Water Program, 2023; Water Rights, 2023c)

Permit No.	Name	Status	Use Type	Authorized Diversion Rate (cfs)	Priority Date	Estimated Use (acre-feet/year)	Estimation Method
1793-1	Autumn Meadows Sanitary District	LC	SHD	0.170	05/13/2003	4.48	Average
716-1	City of Newell	LC	MUN	0.440	09/27/1963	78	Average
731-1	City of Newell	LC	MUN	0.440	06/10/1964		
1597-1	Crooked Oaks Canyon HOA	LC	SHD	0.100	03/22/1994	4.48	Average
2448-2	Heartland Country Ranchettes	LC	SHD	0.089	10/04/2000	7	Average
1861-1	Horseshoe Acres HOA	LC	SHD	0.170	04/20/2006	10	Average
1278-2	Lakeside Water Users District	LC	RWS	0.500	07/21/1975	57	Average
1656-1	Lofty Pines HOA	LC	SHD	0.085	01/02/1998	4.48	Average
2268-2	Prairie Acres LLC	LC	SHD	0.220	03/09/1993	24	Average
794-2	Town of Buffalo Gap	LC	MUN	0.190	03/11/1963	13	Average
660-2	Town of New Underwood	LC	MUN	0.450	03/03/1961	62	Average
1947-2	Town of New Underwood	LC	MUN	0.410	06/03/1981		
366-1	Town of Nisland	LC	MUN	0.150	01/01/1939	19	Average
LC: Licensed Water Right, SHD: Suburban Housing Development, MUN: Municipal, RWS: Rural Water System						<b>TOTAL:</b>	283

Table 5 summarizes the remaining 112 Inyan Kara aquifer non-irrigation water rights/permits (not supplied by RWS, required to report, or operating a CAFO) with the estimated annual use for each water right/permit as determined by their authorized maximum diversion rate or annual volume. Historically, average water use by non-irrigation appropriations limited by an instantaneous diversion rate have been assumed to be pumping 60% of full time at the respective authorized maximum diversion rate. Water rights/permits limited by an annual volume are assumed to withdraw their entire respective annual volume limitation. This is a standard method used by the DANR-Water Rights Program for estimating annual withdrawals by non-irrigation appropriations from an aquifer (Water Rights, 2023c). The use type determined for each water right/permit was based on the primary use categorized for each water right/permit as some permits have multiple uses (Water Rights, 2023c). Overall, the average annual withdrawal rate for the 112 remaining non-irrigation water rights/permits authorized to appropriate water from the Inyan Kara aquifer is approximately 7,483 acre-feet per year (Table 5) (Water Rights, 2023c and 2023f).

**Table 5.** Summary of the Inyan Kara aquifer non-irrigation water rights/permits (not supplied by RWS, required to report, or operating a CAFO) with estimated annual use determined by their respective diversion rate or annual volume (Water Rights, 2023c)

Use Type	No. of Water Rights/Permits	Appropriation for Water Rights/Permits limited by Volume (acre-feet/year)	Appropriation for Water Rights/Permits limited by Diversion Rate (cfs)	Total Estimated Use (acre-feet/year)
<b>RWS</b>	13	N/A	2.827	1,228.7
<b>SHD</b>	20	N/A	3.035	1,319.1
<b>REC</b>	2	N/A	0.203	88.2
<b>COM</b>	36	121	3.93	1,830.4
<b>DOM</b>	13	N/A	1.43	622.8
<b>FWP</b>	5	63.8	0.12	116
<b>GEO</b>	2	N/A	0.24	104.3
<b>INS</b>	1	N/A	0.1	43.5
<b>IND</b>	7	N/A	0.801	348.1
<b>MUN</b>	13	N/A	4.1	1,782
<b>TOTAL:</b>	<b>112</b>	<b>184.8</b>	<b>16.79</b>	<b>7,483</b>
RWS: Rural Water System, SHD: Suburban Housing Development, REC: Recreation, COM: Commercial, DOM: Domestic,				
FWP: Fish & Wildlife Propagation, GEO: Geothermal, INS: Institutional, IND: Industrial, MUN: Municipal				

There are 17 water rights/permits currently authorized to appropriate water from the Inyan Kara aquifer for irrigation use (Water Rights, 2023c). Generally, irrigation water rights/permits are required to report their annual water usage. The average annual withdrawal rate for irrigation appropriations for the Inyan Kara aquifer (that have reported) over the period of record (1982-2021) is approximately 81 acre-feet per year (Table 6) (Water Rights, 2023a). To reflect the current development of irrigation water rights/permits more accurately, the estimated average annual withdrawal rate for the irrigation appropriations from 2012 to 2021 is approximately 129 acre-feet per year (Table 6) (Water Rights, 2023a).

Currently, 12 out of the 17 irrigation water rights/permits are required to report their annual water usage. Table 6 lists 11 water rights/permits as reporting which includes Water Right No. 1961-1, which was cancelled in May of 2023, resulting in only 10 water rights/permits listed as reported in 2021 as being active at this time. Included in the 10 active water rights/permits listed as reported in 2021 are Water Permits Nos. 2799-3 and 8455-3, each of which zero acre-feet per year was reported for as withdrawing in 2021 (Water Permit No. 8455-3 is still within construction period, Water Permit No. 2799-3 reported no water available and has not reported any withdrawals from the aquifer at this time) (Water Rights, 2023a and 2023c).

Additionally, Water Permit Nos. 8334-3 and 1762B-1 are still within their respective construction periods and have not reported any withdrawals from the aquifer at this time (Water Rights, 2023a and 2023c).

The nine irrigation water rights/permits that are not required to report, are still within their construction period, or have not reported any withdrawals from the aquifer at this time are assumed to apply twelve inches of water (compared to maximum allowable volume of two acre-feet per year) over the 647 acres permitted/licensed, which results in a withdrawal rate of



approximately 647 acre-feet per year (Water Rights, 2023c). Generally, irrigators in South Dakota apply less than one foot of water per acre per year. However, to account for the fluctuation in wet and dry cycles from year to year, the one foot of water per acre per year application rate will be used to somewhat overestimate the annual withdrawal rate for these irrigation water rights/permits. The collective estimated average annual withdrawal rate for the irrigation appropriations from 2012 to 2021 (129 acre-feet/year), plus the estimated average annual withdrawal rate for the irrigation water rights/permits that are not required to report or are still within their construction period (647 acre-feet/year), is approximately 776 acre-feet/year (Table 6) (Water Rights, 2023a and 2023c).

**Table 6.** Reported historic irrigation use from the Inyan Kara aquifer (Water Rights, 2023a)

<b>Year</b>	<b>No. of Permits Reporting</b>	<b>Reported Pumpage (ac-ft)</b>
1982	5	2.53
1983	7	33.17
1984	8	4.5
1985	8	224.6
1986	7	4
1987	6	38
1988	6	54.10
1989	8	18.82
1990	8	33.5
1991	9	25.12
1992	9	26
1993	9	36.41
1994	9	30.56
1995	10	37.42
1996	8	19.81
1997	8	6
1998	8	20.75
1999	6	14.18
2000	6	25.27
2001	6	53.23
2002	7	87.83
2003	6	111.90
2004	7	143.48
2005	7	132.51
2006	8	136.04
2007	8	141.86
2008	9	130.51
2009	9	98.93
2010	9	112.57
2011	9	129.79
2012	9	188.76
2013	9	146.48
2014	9	112.25
2015	7	105.82
2016	7	177.81
2017	8	183.55
2018	9	99.92
2019	10	70.61
2020	11	95.46
2021	11	114.27
<b>Min</b>	5	2.53
<b>Max</b>	11	224.6
<b>Avg</b>	<b>8</b>	<b>80.7</b>
<b>Avg (2012 to 2021)</b>	<b>9</b>	<b>129</b>



Uncontrolled, flowing wells are discharging water from the Inyan Kara aquifer at ground surface, and it is expected water from the aquifer is also being discharged to other aquifers if wells completed into the Inyan Kara aquifer have experienced casing failure. It is currently unknown how much water is being discharged from the Inyan Kara aquifer through uncontrolled, flowing wells. The Water Management Board has previously determined water being discharged through uncontrolled, flowing wells from the Dakota aquifer is not a beneficial use and does not constitute appropriation pursuant to SDCL 46-6-3.1 (Water Rights, 1987). Since discharge from uncontrolled flowing wells is likely to continue until water levels in the aquifer decline to being at or below ground surface, continuing to allow beneficial pumping to occur reduces the amount of water being discharged to waste. Therefore, the Water Management Board has allowed development of the Dakota and Inyan Kara aquifers to continue.

There are domestic wells completed into the Inyan Kara aquifer that do not require a water right/permit, so the withdrawal amount for domestic use is unknown (Water Rights, 2023d). Since the introduction of rural water systems, many domestic wells are likely no longer in use or are not being used as primary water sources. Due to their relatively low diversion rates and the availability of rural water, withdrawals from domestic wells are not considered to be a significant portion of the hydrologic budget for the Inyan Kara aquifer.

### Hydrologic Budget Summary

The estimated average annual recharge to Inyan Kara aquifer is approximately 27,600 acre-feet per year (Bredehoeft et al., 1983; Driscoll and Carter, 2001). The estimated average annual withdrawal rate from the Inyan Kara aquifer totals approximately 14,045 acre-feet per year (including the estimated use for Water Permit Application No. 2032-1, if approved) (listed on Table 7). Based on the hydrologic budget, there is a reasonable probability unappropriated water is available from the Inyan Kara aquifer for the proposed appropriation.

**Table 7.** Estimated use from Inyan Kara aquifer (Water Rights, 2023a, 2023c, and 2023f)

<b>Inyan Kara Aquifer Use Type</b>	<b>No. of Permits</b>	<b>Estimated Withdrawal Rate (acre-feet/year)</b>
<b>Irrigation</b> (required to report) (average 2012 to 2021)	12	129
<b>Irrigation</b> (not required to report or have not reported withdrawals at this time)	5	647
<b>CAFO</b> (not required to report) (diversion rate limited)	14	1,095
Standby/Hooked up to RWS (MUN/SHD)	11	0
<b>Non-Irrigation</b> (required to report to Water Rights Program or Drinking Water Program)	57	4,274
<b>Non-Irrigation</b> (not required to report)	112	7,483
<b>Total Number of Permits :</b>	<b>211</b>	
Future Use Permit No. 1780-2		142
Water Permit Application No. 2686-2 - Abeyance		274.2
<b>Total Withdrawal Rate (acre-feet/year):</b>	<b>213</b>	<b>14,045</b>



## **OBSERVATION WELL DATA:**

Administrative Rule of South Dakota (ARSD) 74:02:05:07 requires that the Water Management Board shall rely upon the record of observation well measurements in addition to other data to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated average annual recharge of the aquifer.

Observation wells provide data on how the aquifer reacts to regional climatic conditions and local pumping. The DNR-Water Rights Program monitors nine observation wells completed into the Inyan Kara aquifer (Water Rights, 2023b). The four closest observation wells to the well the applicant proposes to use are MD-99A (approximately 6.5 miles west), PE-95E (approximately 7.2 miles southwest), PE-95B (approximately 13.2 miles southwest), and MD-89A (approximately 25 miles northwest) (as shown in Figure 1) (Water Rights, 2023b). The hydrographs for these observation wells are displayed in Figures 2 to 5 (Water Rights, 2023b). The data points utilized to construct the hydrographs are measurements of the static water level in the observation wells from the top of the well casing.

Observation well MD-99A has had a history of leakage issues but following well maintenance, current water level readings appear to be accurate and reliable (Water Rights, 2023b).

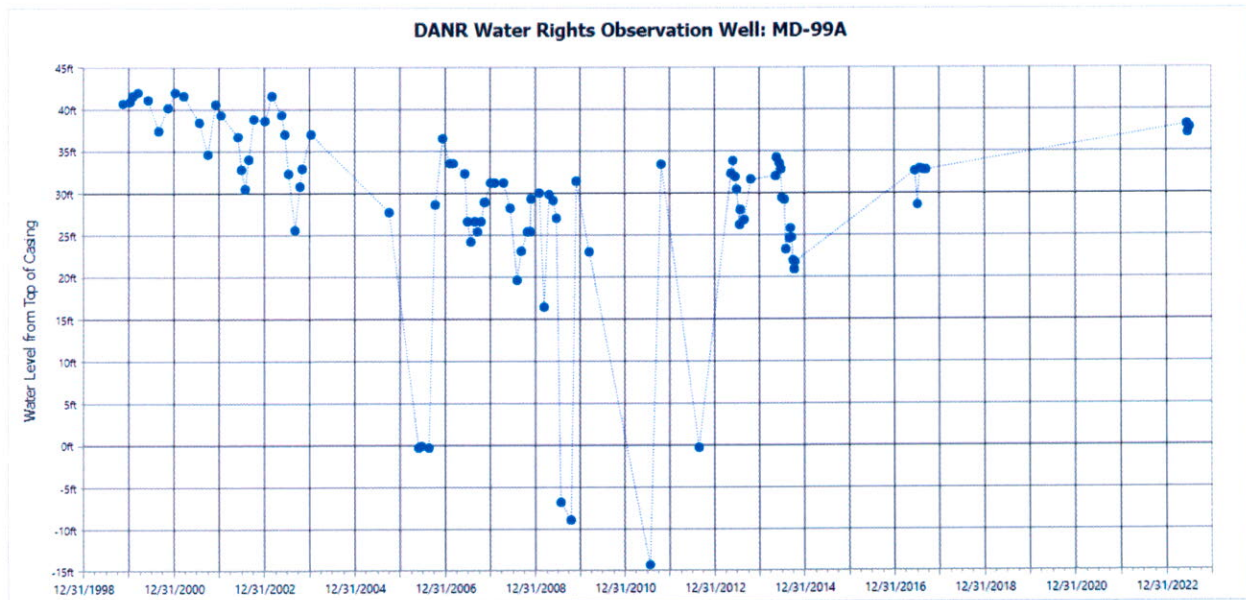
Observation well PE-95E is approximately 1.2 miles from the nearest Inyan Kara Formation outcrop, which is a primary recharge area for the Inyan Kara aquifer. As such, the hydrograph for PE-95E is more reactive to the magnitude of recharge occurring on the outcrop than areas downgradient from the outcrop, resulting in observation wells near the outcrop showing greater fluctuations to seasonal recharge and withdrawals than observation wells further away. Additionally, a decline in water levels in a confined aquifer does not necessarily indicate a significant decrease in water stored in the aquifer, as water levels above the top of the aquifer materials are representative of the hydraulic head (water pressure) inside the aquifer. As development of the Dakota aquifer increased, the decline in hydraulic head in the aquifer created a pressure variance between the Dakota and Inyan Kara aquifers, which causes water to flow from the Inyan Kara aquifer to the Dakota aquifer. If there is a difference in hydraulic head between the two aquifers, flow will continue between the two. In the future, it is possible flows between the Dakota and Inyan Kara aquifers will reach a state of equilibrium. The Water Management Board has previously determined that it is better to allow the Dakota aquifer water to be put to beneficial use than it is to allow it to flow to waste (Water Rights, 1987). That conclusion is expected to apply to the Inyan Kara aquifer as well.

Observation well MD-99A has had a history of leakage issues; however, current water level readings appear to be accurate and reliable (Water Rights, 2023b). The water level readings on the hydrographs for observation wells PE-95B, MD-99A, and MD-89A display stable to increasing water levels over their respective periods of record. The hydrographs for these observation wells were compared to hydrographs for other observations wells completed into the Inyan Kara aquifer and each displayed a generally similar trend as shown on the hydrographs displayed in Figures 2 to 5, apart from ED-85B (Water Rights, 2023b). Between 2009 to 2013, the hydrograph for observation well ED-85B (Figure 6) displays significant fluctuations in water

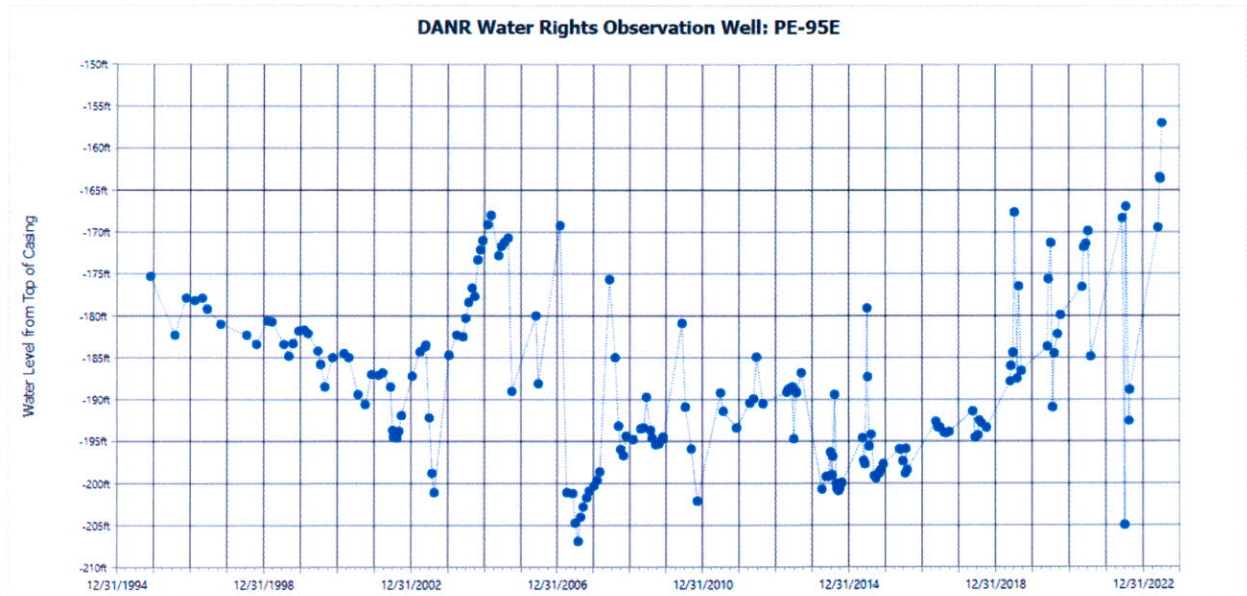


levels that have not happened historically in other Inyan Kara observation wells, which was likely caused by withdrawals from cancelled Water Right No. 6953-3, held by Aberdeen Energy, LLC, authorizing a maximum instantaneous diversion rate of 1.33 cfs from one well completed into the Inyan Kara aquifer, located approximately 2.5 miles west of observation well ED-85B (Water Rights, 2023b and 2023c). Following the cessation of withdrawals previously authorized by Water Right No. 6953-3, the water levels in observation well ED-85B have equilibrated to a similar trend (Water Rights, 2023b and 2023c).

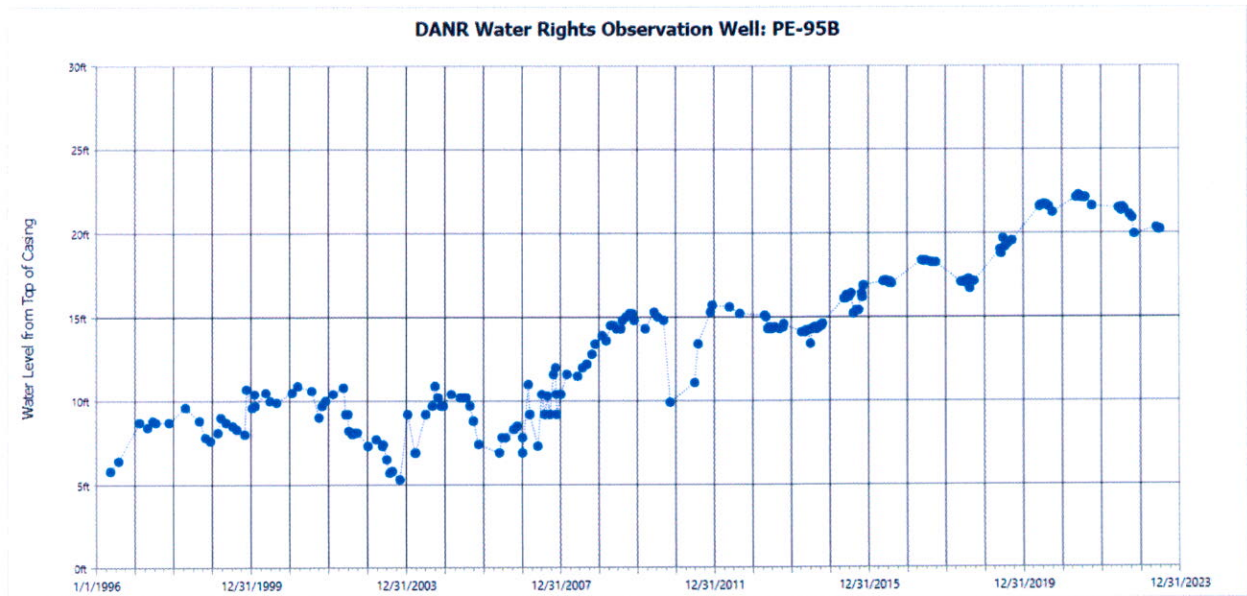
Overall, the effects of climatic conditions are clear on the hydrographs because water levels are rising during wetter periods (early spring snowmelt and precipitation) and slowly declining to a stable water level during drier periods. The hydrographs show the aquifer consistently recovers seasonally is finished and the stable to rising water levels in observation wells shows the aquifer is not being stressed by pumping. Aquifer recovery indicates that climatic conditions and therefore, recharge to and natural discharge from the aquifer govern changes in the water level of the Inyan Kara aquifer rather than pumping. That means recharge to and natural discharge from the aquifer greatly exceeds withdrawals. By recognizing that both recharge to and natural discharge from an aquifer can be captured for pumping, the observation well hydrographs demonstrate there is a reasonable probability unappropriated water is available for the proposed appropriation.



**Figure 2.** Hydrograph for observation well MD-99A (Water Rights, 2023b)



**Figure 3.** Hydrograph for observation well PE-95E (Water Rights, 2023b)



**Figure 4.** Hydrograph for observation well PE-95B (Water Rights, 2023b)



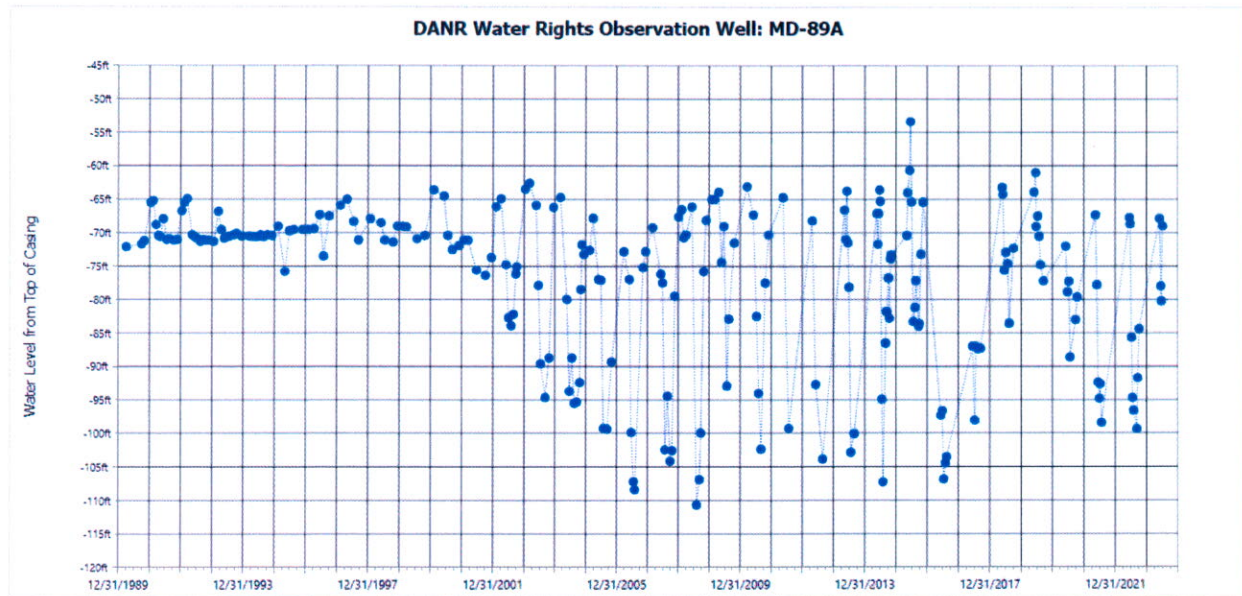


Figure 5. Hydrograph for observation well MD-89A (Water Rights, 2023b)

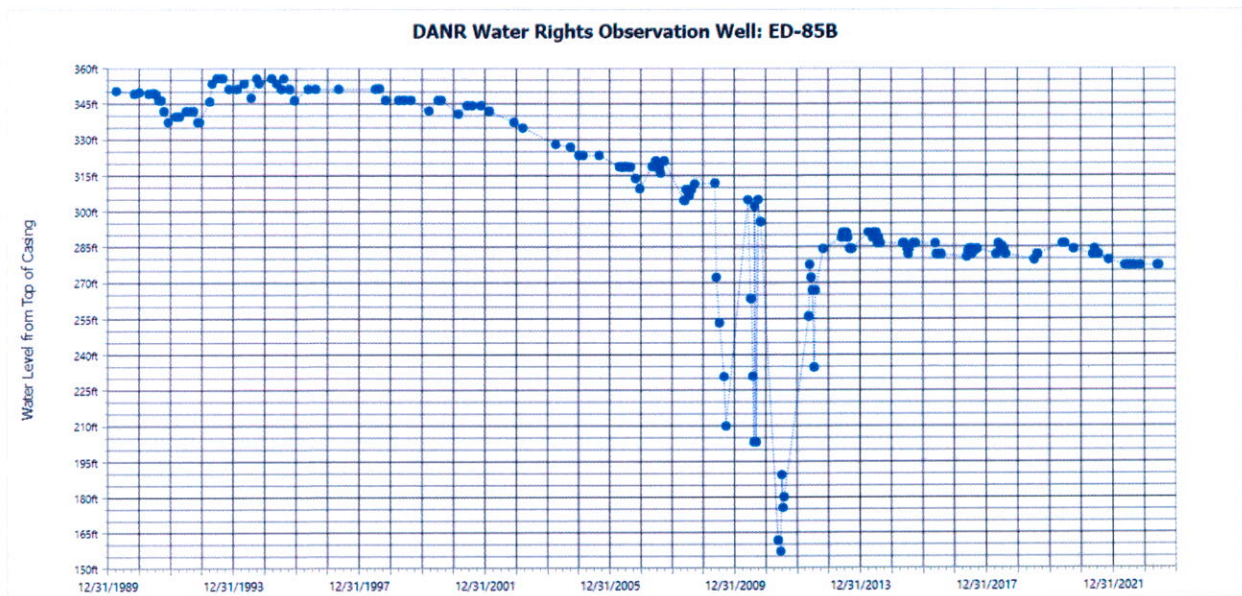


Figure 6. Hydrograph for observation well ED-85B (Water Rights, 2023b)





**Table 8.** Water rights/permits authorized to withdraw from the Inyan Kara aquifer as shown in Figure 7 (Water Rights, 2023c)

Permit No.	Name	Status	Authorized Use	Authorized Diversion Rate (cfs)	Authorized Annual Volume (acre-feet)
585-2	TG Scholl	LC	SHD	0.11	
591-2	City of Box Elder	LC	COM	0.18	
870-2	City of Box Elder	LC	MUN	0.18	
934-2	City of Box Elder	LC	MUN	0.24	
1338-1	Black Hills Petrified Forest	LC	COM	0.03	
1488-1	City of Box Elder	LC	SHD, COM	0.2	
1587-2	Weston Heights Home Owners	LC	SHD	0.11	
1597-1	Crooked Oaks Canyon Homeowners Assn	LC	SHD	0.1	
1656-1	Lofty Pines Homeowners	LC	SHD	0.085	
1664-1	Buffalo Ridge Water Users	LC	SHD	0.1	
1678-2	Harmony Heights Water Company	LC	SHD	0.04	
1688-1	Jake or Lynn Mooney	LC	COM, DOM	0.089	
1689-2	City of Box Elder	LC	MUN	0.36	
1690-1	Tim & Arvid Scott	LC	DOM, COM	0.077	
1700-1	Elk Creek 7 Water Association	LC	SHD	0.111	
1790-2	Berry Patch Campground	LC	COM	0.17	
1793-1	Autumn Meadows Sanitary District	LC	SHD	0.17	
1794-1	Vita Royal Products Inc	LC	COM	0.035	
1796-1	Dennis or Ann Beckham	LC	SHD, COM, DOM	0.1	
1799-1	Deep Water LLC	LC	SHD	0.107	
1812-1	RDT Water Association LLC	LC	SHD	0.078	
1826-1	Golden Valley Water Company LLC	LC	SHD	0.267	
1837-1	Guy Mann	LC	SHD	0.2	
1846-1	Dennis or Ann Mae Beckham	LC	SHD, DOM	0.1	
1861-1	Horseshoe Acres Water Association	LC	SHD	0.17	
1876-1	Elk Creek 7 Water Association	LC	SHD	0.08	
1920-1	Elk Valley Ranchettes Homeowners Assn	LC	SHD	0.1	
1968-1	Venekamps LLC	LC	WDS	0.11	29
1996-1	Dylan Gingras	PE	WDS	0.133	48
1999-1	Rafter Properties LLC	PE	WDS	0.17	74
2051-2	CVRC Limited Partnership	LC	COM	0.356	
2225-2	Flying J Travel Plaza	LC	COM	0.155	
2268-2	Prairie Acres LLC	LC	SHD	0.22	
2334-2	GLM Land Corporation	LC	RWS	0.067	
2425-2	Country Road Estates LLC	LC	SHD	0.111	
2426-2	Pirate's Cove Rapid City	LC	IRR, COM	0.067	
2778-2	Western Construction Inc	PE	COM, IND	0.17	31
2832-2	Reel Simple	PE	WDS	0.044	10
LC: Licensed Water Right; PE: Water Permit; COM: Commercial; DOM: Domestic; IRR: Irrigation; MUN: Municipal;					
RWS: Rural Water System; SHD: Suburban Housing Development; WDS: Water Distribution System					

The Inyan Kara aquifer is primarily under confined conditions, except where it outcrops in the Black Hills (SDGS, 2023; Water Rights, 2023b and 2023d). Based on the submitted well completion report, well completion reports on file for nearby wells completed into the aquifer, and lithologic logs on file for nearby observation wells, the Inyan Kara aquifer is confined at the existing well location (SDGS, 2023; Water Rights, 2023b and 2023d). Drawdown created by pumping a well generally does not extend far from the pumped well in an unconfined aquifer; however, in a confined aquifer, drawdown from pumping could extend a distance from the diversion point. The exact drawdown behavior of a well cannot be known without an aquifer performance test; however, observation wells completed into the Inyan Kara aquifer near licensed/permitted diversion points can provide some insight on how the aquifer responds to pumping.

Observation well PE-95E (approximately 7.2 miles southwest of existing well location) has two high-yield (assumed to be a well with an authorized diversion rate greater than 0.2 cfs) wells within approximately two miles of it (Water Rights, 2023b and 2023c). The drawdown from pumping can be seen on the hydrograph for PE-95E, along with the aquifer returning to pre-pumping conditions seasonally (Figure 3) (Water Rights, 2023b). The lithologic log on file for PE-95E noted the well was drilled approximately 1,450 feet below the ground surface, has a casing stick up height of zero feet, and the top of aquifer materials at approximately 1,080 feet below the ground surface (SDGS, 2023). The lowest recorded static water level on the hydrograph is approximately 207 feet below the top of the well casing, which indicates there was still approximately 875 feet of artesian head pressure in PE-95E even during a drier period when wells are expected to be pumping more water and when water levels are generally naturally lower in response to drier conditions (SDGS, 2023; Water Rights, 2023b).

At the existing well site, the Inyan Kara aquifer has an average saturated thickness of approximately 320 feet with the depth to top of aquifer materials approximately 1,740 feet below grade according to the well completion report submitted with Water Permit Application No. 2032-1 (Water Rights, 2023d). This would generally allow for enough thickness for a pump to be placed 20 feet below the top of the aquifer, which is required for the well to be considered adequate under ARSD 74:02:04:20(6). Any drawdown as a result of the diversion for this application is not expected to unlawfully impair nearby adequate wells. In Meade and Pennington Counties, there are no substantiated complaints on file with the DANR-Water Rights Program regarding well interference for adequate wells completed into the Inyan Kara aquifer (Water Rights, 2023e).

The Water Management Board recognizes that putting water to beneficial use requires a certain amount of drawdown to occur. The Board has developed rules to allow water to be placed to maximum beneficial use without the necessity of maintaining artesian head pressure for domestic use. The Water Management Board defined an “adversely impacted domestic well” in ARSD 74:02:04:20(7) as:

“A well in which the pump intake was set at least 20 feet below the top of the aquifer at the time of construction or, if the aquifer is less than 20 feet thick, is as near to the bottom of the aquifer as is practical and the water level of the aquifer



has declined to a level that the pump will no longer deliver sufficient water for the well owner's needs.”

The Water Management Board considered the delivery of water by artesian head pressure versus maximum beneficial use during the issuance of Water Right No. 2313-2 for Coca-Cola Bottling Company of the Black Hills. The Board adopted the Findings of Facts and Conclusions of Law that noted the reservation of artesian head pressure for delivery of water would be inconsistent with SDCL 46-1-4 which states, “general welfare requires that the water resources of the state be put to beneficial use to the fullest extent of which they are capable...” (Water Rights, 1995). Furthermore, the Water Management Board found if increased cost or decreased production as a result of impacts on artesian head pressure by legitimate users is to be considered as an unlawful impairment, it would also conflict with SDCL 46-1-4 (Water Rights, 1995). With that in mind, some existing well owners may need to install or lower pumps depending on the specific characteristics of the Inyan Kara aquifer at their location. However, when considering the statutes (SDCL 46-1-4 and 46-6-6.1), rules (ARSD 74:02:04:20(6) and (7)), the saturated thickness of the Inyan Kara aquifer at the applicant's location, and the lack of well interference complaints, any drawdown created from the proposed diversion is not expected to cause an unlawful impairment to existing water right/permit holders or domestic uses with adequate wells. Therefore, there is a reasonable probability that any interference from the proposed appropriation will not impose unlawful impairments to existing users with adequate wells.

### **Special Considerations: Adequate Well Required**

ARSD 74:02:04:36 provides alternative well construction standards for certain Inyan Kara aquifer wells that will be used for “private and reasonable domestic use and for noncommercial livestock watering.” Wells constructed according to those standards do not meet the ARSD 74:02:04:20(6) definition of an adequate well because a pump cannot be placed in the formation using that construction method. This application is not for private reasonable domestic use or for noncommercial livestock watering, so any replacement well that may be drilled in the future must be an adequate well drilled to develop this application and may not use the alternative well construction method previously mentioned.

### **CONCLUSIONS:**

1. Water Permit Application No. 2032-1 proposes to appropriate an amount of water not to exceed 30 acre-feet of water annually at a maximum instantaneous diversion rate of 0.167 cfs from one well completed into the Inyan Kara aquifer (2,090 feet deep). The water is for use in a water distribution system. The site of interest is located in Meade County approximately 11 miles east of Piedmont, SD.
2. Based on the hydrologic budget and observation well data, there is a reasonable probability that unappropriated water is available from the Inyan Kara aquifer to supply the proposed appropriation.

3. There is a reasonable probability that the proposed diversion by Water Permit Application No. 2032-1 will not unlawfully impair adequate wells for existing water rights/permits and domestic uses.

*Nakaila Steen*

Nakaila Steen  
Natural Resources Engineer II  
SD DANR - Water Rights Program

Reviewed by:

*Adam Mathiowetz*

Adam Mathiowetz, PE  
Natural Resources Engineer IV  
SD DANR - Water Rights Program

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